



## Full wwPDB EM Validation Report ⓘ

Dec 12, 2022 – 08:43 AM EST

PDB ID : 2ZZ9  
Title : Structure of aquaporin-4 S180D mutant at 2.8 Å resolution by electron crystallography  
Authors : Tani, K.; Mitsuma, T.; Hiroaki, Y.; Kamegawa, A.; Nishikawa, K.; Tanimura, Y.; Fujiyoshi, Y.  
Deposited on : 2009-02-06  
Resolution : 2.80 Å(reported)

This is a Full wwPDB EM Validation Report for a publicly released PDB/EMDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<https://www.wwpdb.org/validation/2017/EMValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.31.2

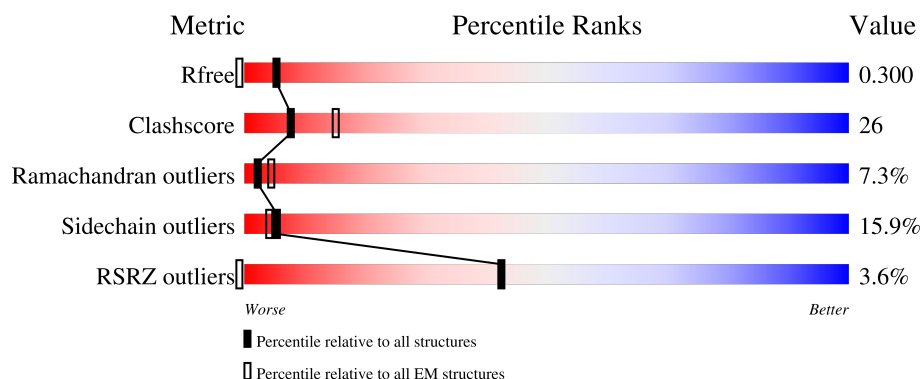
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*ELECTRON CRYSTALLOGRAPHY*

The reported resolution of this entry is 2.80 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	EM structures (#Entries)
$R_{free}$	130704	0
Clashscore	158937	4297
Ramachandran outliers	154571	4023
Sidechain outliers	154315	3826
RSRZ outliers	127900	0

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions  $\leq 5\%$ .

Mol	Chain	Length	Quality of chain
1	A	301	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	PEE	A	401	X	-	-	-
2	PEE	A	402	X	-	-	-

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	PEE	A	403	X	-	-	X
2	PEE	A	404	X	-	-	-
2	PEE	A	405	X	-	-	X

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 1867 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

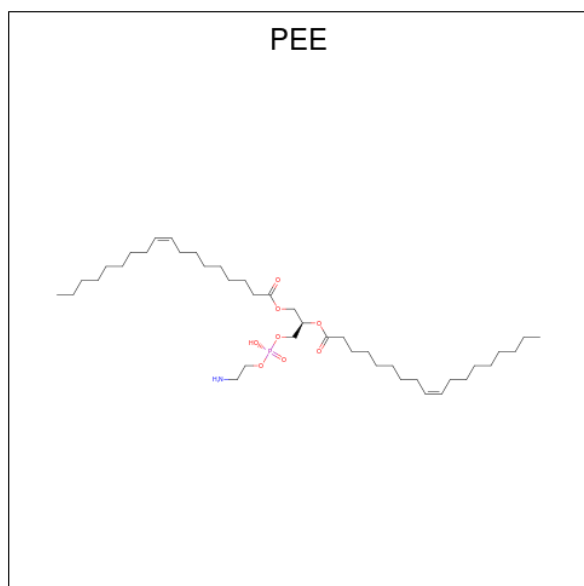
- Molecule 1 is a protein called Aquaporin-4.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	223	1642	1079	265	286	12	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	180	ASP	SER	engineered mutation	UNP P47863

- Molecule 2 is 1,2-dioleoyl-sn-glycero-3-phosphoethanolamine (three-letter code: PEE) (formula: C<sub>41</sub>H<sub>78</sub>NO<sub>8</sub>P).



Mol	Chain	Residues	Atoms					AltConf
			Total	C	N	O	P	
2	A	1	211	161	5	40	5	0
2	A	1	211	161	5	40	5	0
2	A	1	211	161	5	40	5	0

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Mol	Chain	Residues	Atoms					AltConf
2	A	1	Total	C	N	O	P	0
			211	161	5	40	5	
2	A	1	Total	C	N	O	P	0
			211	161	5	40	5	

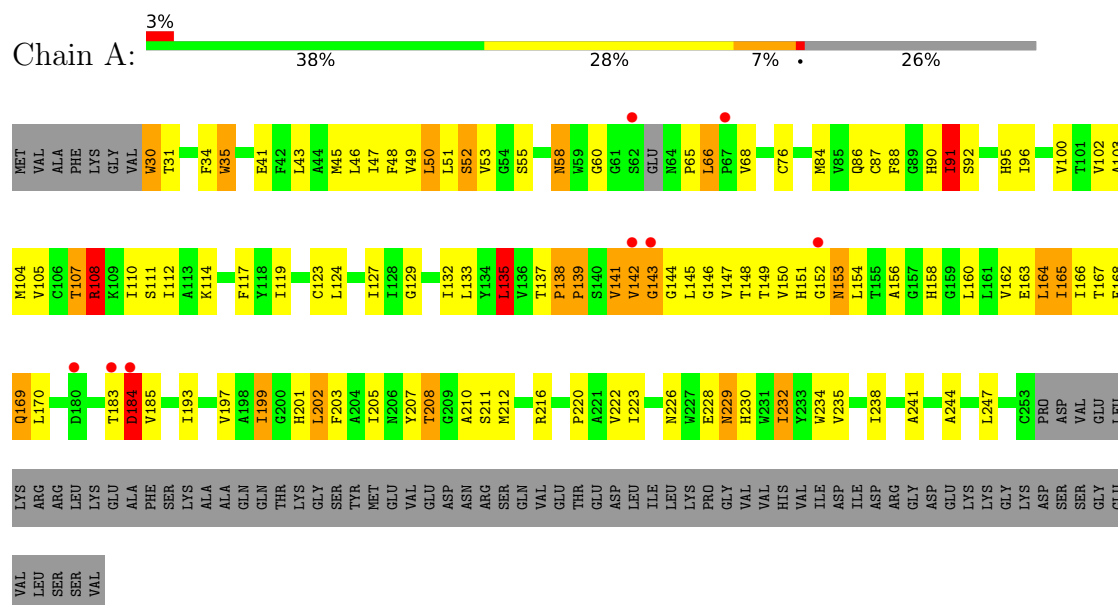
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		AltConf
3	A	14	Total	O	0
			14	14	

### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

#### • Molecule 1: Aquaporin-4



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 4 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	69.00Å 69.00Å 160.00Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 2.80 16.89 – 2.80	Depositor EDS
% Data completeness (in resolution range)	81.9 (10.00-2.80) 86.7 (16.89-2.80)	Depositor EDS
$R_{merge}$	0.20	Depositor
$R_{sym}$	0.20	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.96 (at 2.78Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.231 , 0.288 0.245 , 0.300	Depositor DCC
$R_{free}$ test set	487 reflections (5.57%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	49.3	Xtriage
Anisotropy	1.033	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 106.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.42$ , $\langle L^2 \rangle = 0.24$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.90	EDS
Total number of atoms	1867	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	53.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.47% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: PEE

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with  $|Z| > 5$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z  > 5$	RMSZ	$\# Z  > 5$
1	A	0.56	0/1683	0.70	2/2296 (0.1%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	164	LEU	CA-CB-CG	7.25	131.98	115.30
1	A	135	LEU	CA-CB-CG	5.56	128.10	115.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1642	0	1646	88	0
2	A	211	0	292	15	0
3	A	14	0	0	0	0
All	All	1867	0	1938	97	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 26.

All (97) close contacts within the same asymmetric unit are listed below, sorted by their clash



magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:58:ASN:HD21	1:A:66:LEU:H	1.02	0.96
1:A:151:HIS:CE1	1:A:153:ASN:HA	2.00	0.94
1:A:49:VAL:O	1:A:53:VAL:HB	1.70	0.91
1:A:151:HIS:CG	1:A:152:GLY:H	1.91	0.88
1:A:138:PRO:CB	1:A:139:PRO:CD	2.55	0.83
1:A:138:PRO:HB2	1:A:139:PRO:CD	2.09	0.83
1:A:151:HIS:CD2	1:A:152:GLY:H	1.98	0.80
1:A:58:ASN:HD21	1:A:66:LEU:N	1.81	0.79
1:A:138:PRO:HB2	1:A:139:PRO:HD2	1.66	0.77
1:A:158:HIS:O	1:A:162:VAL:HG23	1.83	0.77
1:A:124:LEU:HD22	2:A:403:PEE:H58	1.70	0.72
1:A:208:THR:HG22	1:A:210:ALA:H	1.53	0.72
1:A:199:ILE:HA	1:A:202:LEU:HB2	1.74	0.68
1:A:141:VAL:O	1:A:143:GLY:N	2.28	0.67
1:A:151:HIS:CG	1:A:152:GLY:N	2.63	0.66
1:A:138:PRO:CB	1:A:139:PRO:HD3	2.23	0.66
1:A:127:ILE:HD11	1:A:222:VAL:HG21	1.78	0.66
1:A:151:HIS:CE1	1:A:153:ASN:CA	2.78	0.65
1:A:46:LEU:HD11	1:A:132:ILE:HD12	1.77	0.65
2:A:403:PEE:H61	2:A:403:PEE:H73	1.78	0.65
1:A:138:PRO:HB3	1:A:139:PRO:HD3	1.81	0.63
1:A:152:GLY:O	1:A:153:ASN:HB2	1.99	0.62
1:A:165:ILE:O	1:A:168:PHE:HB3	2.00	0.61
1:A:163:GLU:OE1	1:A:166:ILE:HD11	2.00	0.61
1:A:47:ILE:HB	1:A:84:MET:HE2	1.82	0.61
1:A:110:ILE:HD12	1:A:114:LYS:HD2	1.83	0.60
1:A:168:PHE:CD2	1:A:244:ALA:HB2	2.38	0.59
1:A:108:ARG:HD2	2:A:405:PEE:H2	1.85	0.58
2:A:405:PEE:H19	2:A:405:PEE:H63	1.85	0.58
1:A:108:ARG:HH21	2:A:405:PEE:H3	1.69	0.58
2:A:401:PEE:H36	2:A:403:PEE:H28	1.85	0.57
1:A:35:TRP:CH2	1:A:117:PHE:CE2	2.92	0.57
1:A:53:VAL:HG13	1:A:145:LEU:O	2.05	0.57
1:A:91:ILE:O	1:A:91:ILE:HD13	2.05	0.56
1:A:50:LEU:HD23	1:A:133:LEU:HD13	1.87	0.56
1:A:133:LEU:O	1:A:137:THR:HG22	2.06	0.56
1:A:107:THR:CG2	1:A:107:THR:O	2.54	0.56
1:A:30:TRP:HE3	1:A:31:THR:HG1	1.56	0.54
1:A:132:ILE:O	1:A:135:LEU:HD22	2.08	0.54
1:A:229:ASN:O	1:A:232:ILE:HB	2.08	0.54
1:A:45:MET:O	1:A:49:VAL:HG13	2.08	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:148:THR:HG21	1:A:211:SER:HB2	1.89	0.53
1:A:34:PHE:CE2	1:A:114:LYS:HG2	2.43	0.53
1:A:95:HIS:O	1:A:96:ILE:HG22	2.08	0.53
1:A:105:VAL:HG11	2:A:405:PEE:H21	1.91	0.53
1:A:147:VAL:HG12	1:A:220:PRO:HB2	1.91	0.52
1:A:52:SER:HA	1:A:76:CYS:SG	2.51	0.51
1:A:230:HIS:HD2	2:A:402:PEE:H21	1.74	0.51
1:A:108:ARG:HH21	2:A:405:PEE:C1	2.23	0.51
1:A:46:LEU:HD12	1:A:129:GLY:HA2	1.93	0.51
1:A:156:ALA:HB1	1:A:232:ILE:HD11	1.92	0.51
1:A:151:HIS:HE1	1:A:153:ASN:HA	1.72	0.50
1:A:35:TRP:CH2	1:A:117:PHE:HE2	2.28	0.50
1:A:163:GLU:OE1	1:A:163:GLU:HA	2.12	0.49
1:A:41:GLU:HG2	1:A:92:SER:OG	2.13	0.49
1:A:150:VAL:HG21	1:A:232:ILE:HG21	1.95	0.49
1:A:211:SER:O	1:A:212:MET:HG3	2.13	0.48
1:A:102:VAL:HG11	1:A:238:ILE:HG23	1.95	0.48
1:A:170:LEU:HD22	1:A:212:MET:SD	2.54	0.48
1:A:183:THR:O	1:A:184:ASP:C	2.52	0.48
1:A:208:THR:CG2	1:A:210:ALA:H	2.26	0.48
1:A:110:ILE:HG23	1:A:114:LYS:HB3	1.95	0.47
1:A:163:GLU:CD	1:A:208:THR:HG21	2.35	0.47
2:A:401:PEE:H10	2:A:403:PEE:N	2.30	0.47
1:A:43:LEU:HD23	1:A:46:LEU:HD23	1.97	0.47
1:A:127:ILE:O	1:A:223:ILE:HD11	2.15	0.47
1:A:162:VAL:O	1:A:166:ILE:HG12	2.14	0.46
1:A:193:ILE:O	1:A:197:VAL:HG23	2.15	0.46
1:A:201:HIS:O	1:A:205:ILE:HG13	2.17	0.45
1:A:170:LEU:HB2	1:A:212:MET:HE1	1.98	0.44
1:A:228:GLU:O	1:A:229:ASN:ND2	2.51	0.44
1:A:30:TRP:HB3	1:A:31:THR:H	1.67	0.44
2:A:405:PEE:H63	2:A:405:PEE:H24	2.00	0.44
1:A:47:ILE:HG23	1:A:51:LEU:HD23	1.99	0.43
1:A:203:PHE:CE1	1:A:207:TYR:CE2	3.06	0.43
2:A:403:PEE:H37	2:A:404:PEE:H35	2.01	0.43
1:A:103:ALA:HB2	1:A:241:ALA:HB1	2.00	0.43
2:A:405:PEE:H14	2:A:405:PEE:H50	2.00	0.43
1:A:34:PHE:HE2	1:A:114:LYS:HG2	1.82	0.43
1:A:151:HIS:CE1	1:A:153:ASN:N	2.87	0.43
1:A:230:HIS:NE2	1:A:234:TRP:NE1	2.55	0.42
1:A:88:PHE:O	1:A:91:ILE:HG22	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:55:SER:HB2	1:A:76:CYS:SG	2.60	0.42
1:A:141:VAL:O	1:A:142:VAL:C	2.57	0.42
1:A:119:ILE:O	1:A:123:CYS:N	2.53	0.42
1:A:152:GLY:O	1:A:153:ASN:CB	2.66	0.42
1:A:127:ILE:CD1	1:A:222:VAL:HG21	2.48	0.41
1:A:87:CYS:O	1:A:90:HIS:HE1	2.02	0.41
1:A:144:GLY:C	1:A:146:GLY:N	2.73	0.41
1:A:166:ILE:HG13	1:A:167:THR:N	2.35	0.41
1:A:46:LEU:CD1	1:A:129:GLY:HA2	2.50	0.41
2:A:405:PEE:H19	2:A:405:PEE:H58	2.03	0.41
1:A:48:PHE:O	1:A:52:SER:OG	2.37	0.41
2:A:403:PEE:H68	2:A:403:PEE:H42	2.02	0.40
1:A:100:VAL:O	1:A:104:MET:HG2	2.21	0.40
1:A:201:HIS:HB3	1:A:205:ILE:HD11	2.04	0.40
1:A:208:THR:HG22	1:A:210:ALA:N	2.29	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	A	219/301 (73%)	176 (80%)	27 (12%)	16 (7%)	<b>1</b> <b>2</b>

All (16) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	65	PRO
1	A	66	LEU
1	A	142	VAL
1	A	184	ASP
1	A	138	PRO
1	A	169	GLN

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Mol	Chain	Res	Type
1	A	202	LEU
1	A	60	GLY
1	A	91	ILE
1	A	108	ARG
1	A	153	ASN
1	A	68	VAL
1	A	143	GLY
1	A	139	PRO
1	A	185	VAL
1	A	199	ILE

### 5.3.2 Protein sidechains ⓘ

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	A	170/243 (70%)	143 (84%)	27 (16%)	<b>2</b> <b>7</b>

All (27) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	30	TRP
1	A	35	TRP
1	A	50	LEU
1	A	52	SER
1	A	58	ASN
1	A	86	GLN
1	A	91	ILE
1	A	107	THR
1	A	108	ARG
1	A	111	SER
1	A	112	ILE
1	A	135	LEU
1	A	141	VAL
1	A	149	THR
1	A	154	LEU
1	A	160	LEU

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Mol	Chain	Res	Type
1	A	164	LEU
1	A	165	ILE
1	A	169	GLN
1	A	184	ASP
1	A	208	THR
1	A	216	ARG
1	A	226	ASN
1	A	229	ASN
1	A	232	ILE
1	A	235	VAL
1	A	247	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	32	GLN
1	A	58	ASN
1	A	151	HIS
1	A	206	ASN
1	A	226	ASN
1	A	229	ASN

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

### 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

5 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with  $|Z| > 2$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z  > 2$	Counts	RMSZ	$\# Z  > 2$
2	PEE	A	401	-	43,43,50	4.91	8 (18%)	46,48,55	4.29	6 (13%)
2	PEE	A	403	-	48,48,50	4.55	8 (16%)	51,53,55	3.48	5 (9%)
2	PEE	A	404	-	33,33,50	5.54	6 (18%)	36,38,55	4.12	7 (19%)
2	PEE	A	402	-	48,48,50	4.67	8 (16%)	51,53,55	3.58	5 (9%)
2	PEE	A	405	-	34,34,50	5.30	6 (17%)	37,39,55	4.21	8 (21%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	PEE	A	401	-	1/1/4/8	22/47/47/54	-
2	PEE	A	403	-	1/1/4/8	35/52/52/54	-
2	PEE	A	404	-	1/1/4/8	21/36/36/54	-
2	PEE	A	402	-	1/1/4/8	28/52/52/54	-
2	PEE	A	405	-	1/1/4/8	23/38/38/54	-

All (36) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	402	PEE	C11-C10	30.21	2.39	1.50
2	A	404	PEE	C11-C10	30.20	2.39	1.50
2	A	401	PEE	C11-C10	29.97	2.38	1.50
2	A	403	PEE	C11-C10	29.29	2.36	1.50
2	A	405	PEE	C11-C10	29.05	2.35	1.50
2	A	401	PEE	O4-C10	7.14	1.43	1.22
2	A	402	PEE	O4-C10	7.05	1.43	1.22
2	A	404	PEE	O4-C10	7.04	1.43	1.22
2	A	403	PEE	O4-C10	6.92	1.43	1.22
2	A	405	PEE	O4-C10	6.91	1.43	1.22
2	A	401	PEE	O3-C30	4.68	1.47	1.33

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	403	PEE	O3-C30	4.47	1.46	1.33
2	A	405	PEE	O3-C30	4.43	1.46	1.33
2	A	402	PEE	O3-C30	4.31	1.45	1.33
2	A	404	PEE	C18-C19	3.82	1.53	1.31
2	A	402	PEE	C39-C38	3.76	1.53	1.31
2	A	401	PEE	C18-C19	3.76	1.53	1.31
2	A	403	PEE	C39-C38	3.74	1.53	1.31
2	A	401	PEE	C39-C38	3.68	1.53	1.31
2	A	402	PEE	C18-C19	3.67	1.53	1.31
2	A	401	PEE	O2-C10	3.64	1.44	1.34
2	A	405	PEE	C19-C18	3.62	1.53	1.28
2	A	403	PEE	C18-C19	3.61	1.52	1.31
2	A	405	PEE	C39-C38	3.59	1.52	1.28
2	A	403	PEE	O2-C10	3.49	1.44	1.34
2	A	405	PEE	O2-C10	3.34	1.43	1.34
2	A	402	PEE	O2-C10	3.26	1.43	1.34
2	A	404	PEE	O2-C10	3.24	1.43	1.34
2	A	402	PEE	C21-C22	-3.13	1.34	1.51
2	A	403	PEE	C21-C22	-3.11	1.34	1.51
2	A	401	PEE	C42-C41	-3.10	1.34	1.51
2	A	402	PEE	C42-C41	-3.09	1.34	1.51
2	A	403	PEE	C42-C41	-3.04	1.34	1.51
2	A	404	PEE	C21-C22	-2.95	1.35	1.51
2	A	404	PEE	O3-C30	2.79	1.47	1.33
2	A	401	PEE	C22-C21	-2.52	1.33	1.51

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	402	PEE	O4-C10-C11	-23.16	33.37	123.73
2	A	404	PEE	O4-C10-C11	-23.12	33.52	123.73
2	A	401	PEE	O4-C10-C11	-23.07	33.72	123.73
2	A	403	PEE	O4-C10-C11	-22.94	34.22	123.73
2	A	405	PEE	O4-C10-C11	-22.84	34.62	123.73
2	A	401	PEE	O2-C10-C11	-12.76	83.99	111.50
2	A	401	PEE	C12-C11-C10	8.64	145.04	113.62
2	A	405	PEE	C12-C11-C10	6.73	138.09	113.62
2	A	403	PEE	O2-C10-O4	-6.01	109.17	123.70
2	A	405	PEE	O2-C10-O4	-5.75	109.79	123.70
2	A	402	PEE	O2-C10-O4	-5.62	110.13	123.70
2	A	402	PEE	C12-C11-C10	5.35	133.06	113.62
2	A	404	PEE	O2-C10-O4	-5.26	110.99	123.70

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	401	PEE	O2-C10-O4	-4.97	111.69	123.70
2	A	405	PEE	O2-C10-C11	-4.55	101.69	111.50
2	A	401	PEE	O3-C30-C31	3.80	123.84	111.91
2	A	403	PEE	O3-C30-C31	2.98	121.27	111.91
2	A	402	PEE	C42-C41-C40	2.83	126.12	113.79
2	A	405	PEE	O3-C30-C31	2.80	120.70	111.91
2	A	403	PEE	C42-C41-C40	2.65	125.33	113.79
2	A	404	PEE	C22-C21-C20	2.63	125.26	113.79
2	A	404	PEE	O2-C10-C11	2.63	117.16	111.50
2	A	404	PEE	C21-C22-C23	2.39	126.58	114.42
2	A	402	PEE	O3-C30-C31	2.34	119.26	111.91
2	A	405	PEE	C37-C38-C39	-2.31	111.13	126.84
2	A	404	PEE	C3-O3-C30	2.31	122.91	117.10
2	A	401	PEE	O3-C30-O5	-2.27	117.86	123.59
2	A	405	PEE	C2-O2-C10	-2.24	112.27	117.79
2	A	405	PEE	C17-C18-C19	-2.22	111.78	126.84
2	A	404	PEE	O3-C3-C2	2.20	114.83	108.43
2	A	403	PEE	O3-C30-O5	-2.09	118.31	123.59

All (5) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
2	A	401	PEE	C2
2	A	402	PEE	C2
2	A	403	PEE	C2
2	A	404	PEE	C2
2	A	405	PEE	C2

All (129) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	401	PEE	O4-C10-O2-C2
2	A	401	PEE	C4-O4P-P-O2P
2	A	401	PEE	O4P-C4-C5-N
2	A	401	PEE	O5-C30-O3-C3
2	A	401	PEE	C31-C30-O3-C3
2	A	402	PEE	O4-C10-O2-C2
2	A	402	PEE	C1-O3P-P-O2P
2	A	402	PEE	O4P-C4-C5-N
2	A	403	PEE	C11-C10-O2-C2
2	A	403	PEE	O4-C10-O2-C2
2	A	403	PEE	C1-O3P-P-O2P

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Mol	Chain	Res	Type	Atoms
2	A	403	PEE	C1-O3P-P-O1P
2	A	403	PEE	C4-O4P-P-O2P
2	A	404	PEE	C11-C10-O2-C2
2	A	404	PEE	O4-C10-O2-C2
2	A	404	PEE	C3-C2-O2-C10
2	A	404	PEE	O4P-C4-C5-N
2	A	405	PEE	O4-C10-O2-C2
2	A	405	PEE	C1-O3P-P-O1P
2	A	402	PEE	C40-C41-C42-C43
2	A	403	PEE	C40-C41-C42-C43
2	A	404	PEE	C20-C21-C22-C23
2	A	401	PEE	C17-C18-C19-C20
2	A	402	PEE	C17-C18-C19-C20
2	A	402	PEE	C37-C38-C39-C40
2	A	403	PEE	C17-C18-C19-C20
2	A	403	PEE	C37-C38-C39-C40
2	A	403	PEE	C31-C30-O3-C3
2	A	403	PEE	C21-C22-C23-C24
2	A	401	PEE	C30-C31-C32-C33
2	A	405	PEE	C31-C30-O3-C3
2	A	401	PEE	C10-C11-C12-C13
2	A	405	PEE	C11-C10-O2-C2
2	A	403	PEE	O5-C30-O3-C3
2	A	405	PEE	O5-C30-O3-C3
2	A	401	PEE	C4-O4P-P-O3P
2	A	402	PEE	C1-O3P-P-O4P
2	A	403	PEE	C1-O3P-P-O4P
2	A	405	PEE	C1-O3P-P-O4P
2	A	401	PEE	C15-C16-C17-C18
2	A	402	PEE	C13-C14-C15-C16
2	A	402	PEE	C11-C12-C13-C14
2	A	403	PEE	C14-C15-C16-C17
2	A	402	PEE	C41-C42-C43-C44
2	A	402	PEE	C14-C15-C16-C17
2	A	403	PEE	C32-C33-C34-C35
2	A	405	PEE	C13-C14-C15-C16
2	A	402	PEE	C31-C32-C33-C34
2	A	401	PEE	C34-C35-C36-C37
2	A	405	PEE	C33-C34-C35-C36
2	A	401	PEE	C13-C14-C15-C16
2	A	403	PEE	C19-C20-C21-C22
2	A	405	PEE	C34-C35-C36-C37

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Mol	Chain	Res	Type	Atoms
2	A	402	PEE	C32-C33-C34-C35
2	A	404	PEE	C22-C23-C24-C25
2	A	401	PEE	C11-C12-C13-C14
2	A	402	PEE	C39-C40-C41-C42
2	A	405	PEE	C35-C36-C37-C38
2	A	404	PEE	C31-C30-O3-C3
2	A	402	PEE	C35-C36-C37-C38
2	A	403	PEE	C35-C36-C37-C38
2	A	401	PEE	C12-C13-C14-C15
2	A	403	PEE	C22-C23-C24-C25
2	A	403	PEE	O3P-C1-C2-O2
2	A	405	PEE	O3P-C1-C2-O2
2	A	404	PEE	C11-C12-C13-C14
2	A	403	PEE	C30-C31-C32-C33
2	A	402	PEE	O2-C2-C3-O3
2	A	401	PEE	C38-C39-C40-C41
2	A	402	PEE	C4-O4P-P-O3P
2	A	403	PEE	C4-O4P-P-O3P
2	A	405	PEE	O3P-C1-C2-C3
2	A	405	PEE	C16-C17-C18-C19
2	A	404	PEE	C10-C11-C12-C13
2	A	403	PEE	C41-C42-C43-C44
2	A	402	PEE	C36-C37-C38-C39
2	A	402	PEE	C1-C2-C3-O3
2	A	405	PEE	C15-C16-C17-C18
2	A	401	PEE	C41-C42-C43-C44
2	A	401	PEE	C1-C2-O2-C10
2	A	403	PEE	C3-C2-O2-C10
2	A	405	PEE	C10-C11-C12-C13
2	A	403	PEE	O3P-C1-C2-C3
2	A	404	PEE	O3P-C1-C2-C3
2	A	402	PEE	C30-C31-C32-C33
2	A	402	PEE	C23-C24-C25-C26
2	A	402	PEE	C2-C1-O3P-P
2	A	403	PEE	C2-C1-O3P-P
2	A	404	PEE	O5-C30-O3-C3
2	A	403	PEE	C33-C34-C35-C36
2	A	403	PEE	O2-C10-C11-C12
2	A	405	PEE	C36-C37-C38-C39
2	A	404	PEE	C15-C16-C17-C18
2	A	403	PEE	C34-C35-C36-C37
2	A	402	PEE	C1-O3P-P-O1P

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Mol	Chain	Res	Type	Atoms
2	A	403	PEE	C4-O4P-P-O1P
2	A	405	PEE	C1-O3P-P-O2P
2	A	403	PEE	C39-C40-C41-C42
2	A	405	PEE	C31-C32-C33-C34
2	A	404	PEE	O3P-C1-C2-O2
2	A	404	PEE	C1-C2-C3-O3
2	A	404	PEE	O2-C2-C3-O3
2	A	403	PEE	C15-C16-C17-C18
2	A	403	PEE	C31-C32-C33-C34
2	A	402	PEE	C33-C34-C35-C36
2	A	401	PEE	C1-O3P-P-O4P
2	A	404	PEE	C4-O4P-P-O3P
2	A	405	PEE	C4-O4P-P-O3P
2	A	402	PEE	C22-C23-C24-C25
2	A	404	PEE	C14-C15-C16-C17
2	A	402	PEE	C10-C11-C12-C13
2	A	401	PEE	C32-C33-C34-C35
2	A	403	PEE	C23-C24-C25-C26
2	A	401	PEE	C37-C38-C39-C40
2	A	404	PEE	C23-C24-C25-C26
2	A	401	PEE	O2-C2-C3-O3
2	A	401	PEE	C33-C34-C35-C36
2	A	404	PEE	C16-C17-C18-C19
2	A	405	PEE	C32-C33-C34-C35
2	A	404	PEE	C12-C13-C14-C15
2	A	404	PEE	C18-C19-C20-C21
2	A	405	PEE	C14-C15-C16-C17
2	A	402	PEE	C4-O4P-P-O1P
2	A	405	PEE	C4-O4P-P-O1P
2	A	402	PEE	C5-C4-O4P-P
2	A	405	PEE	C12-C13-C14-C15
2	A	403	PEE	O3-C30-C31-C32
2	A	403	PEE	C11-C12-C13-C14
2	A	403	PEE	O4-C10-C11-C12

There are no ring outliers.

5 monomers are involved in 15 short contacts:

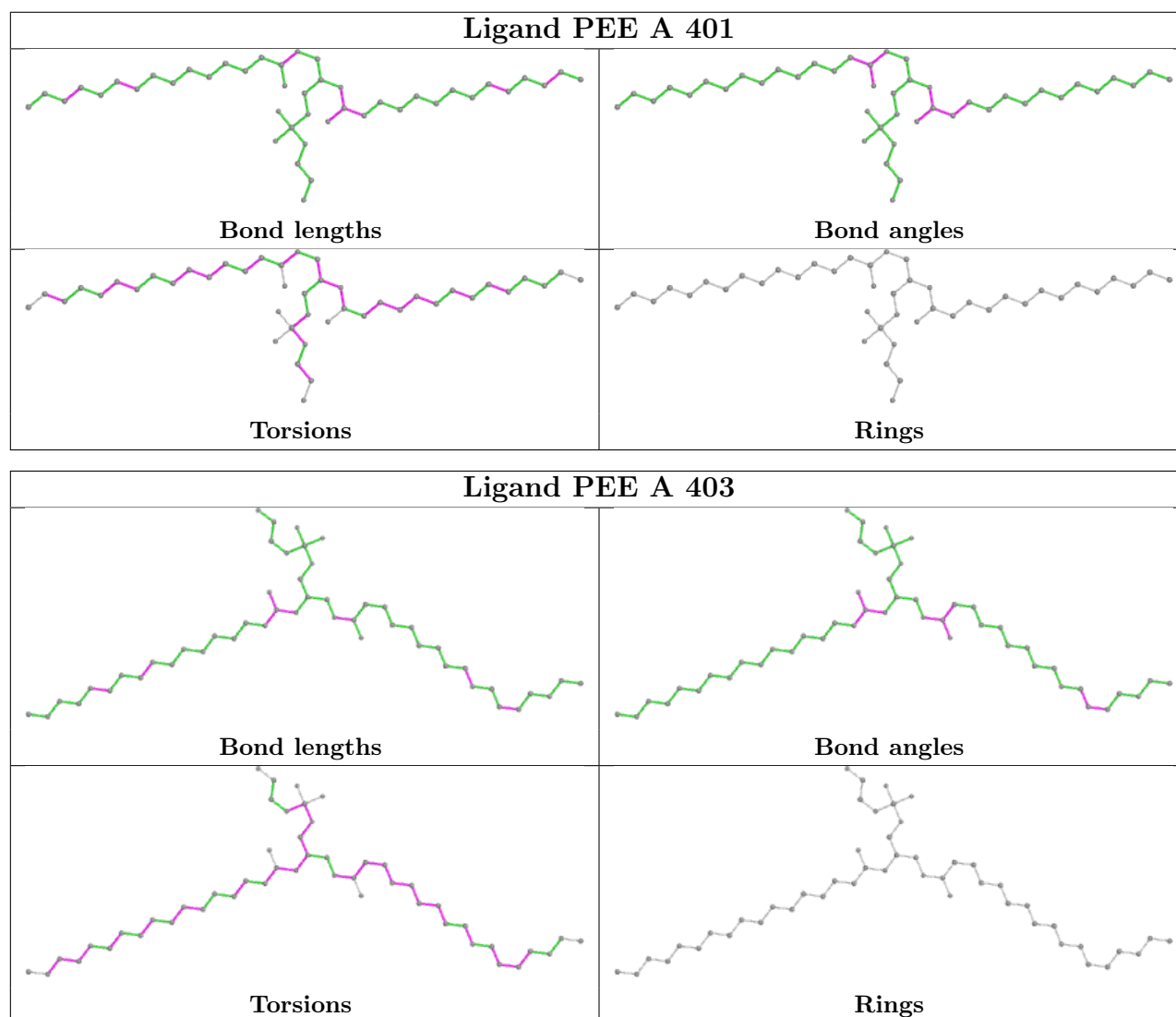
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	401	PEE	2	0
2	A	403	PEE	6	0
2	A	404	PEE	1	0

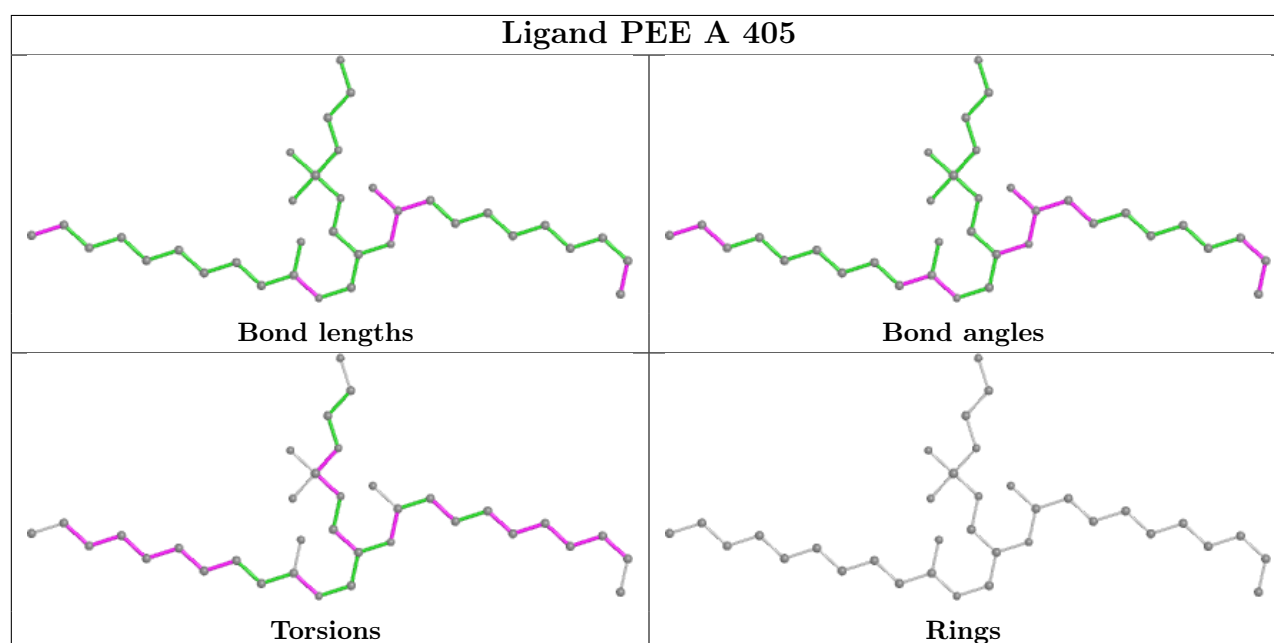
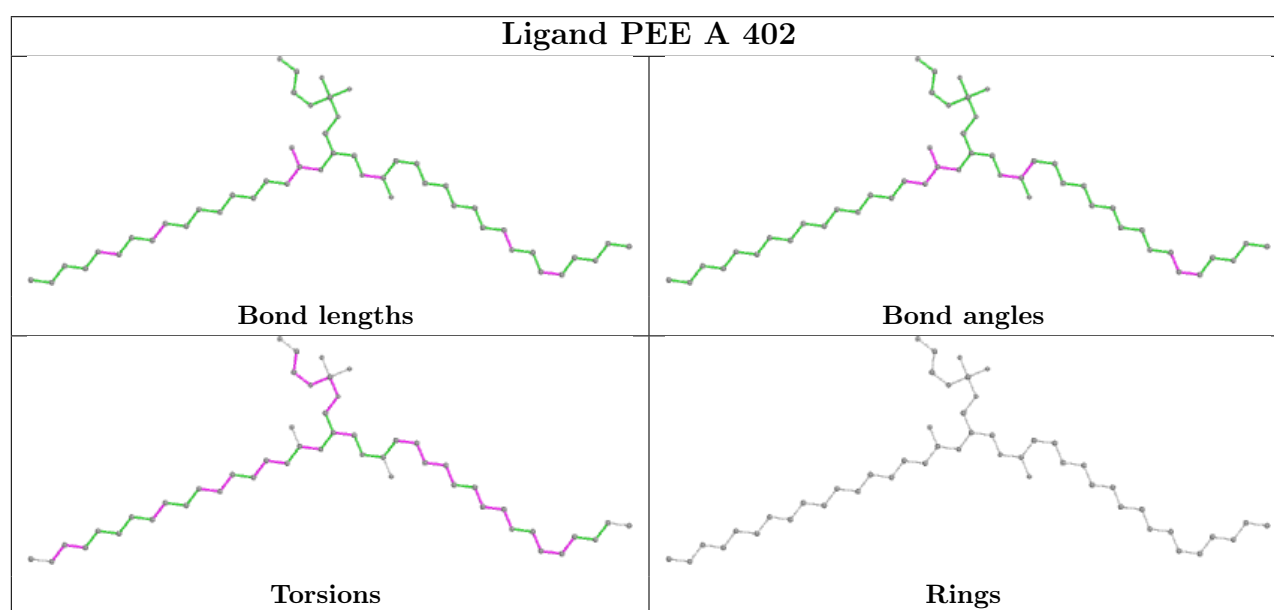
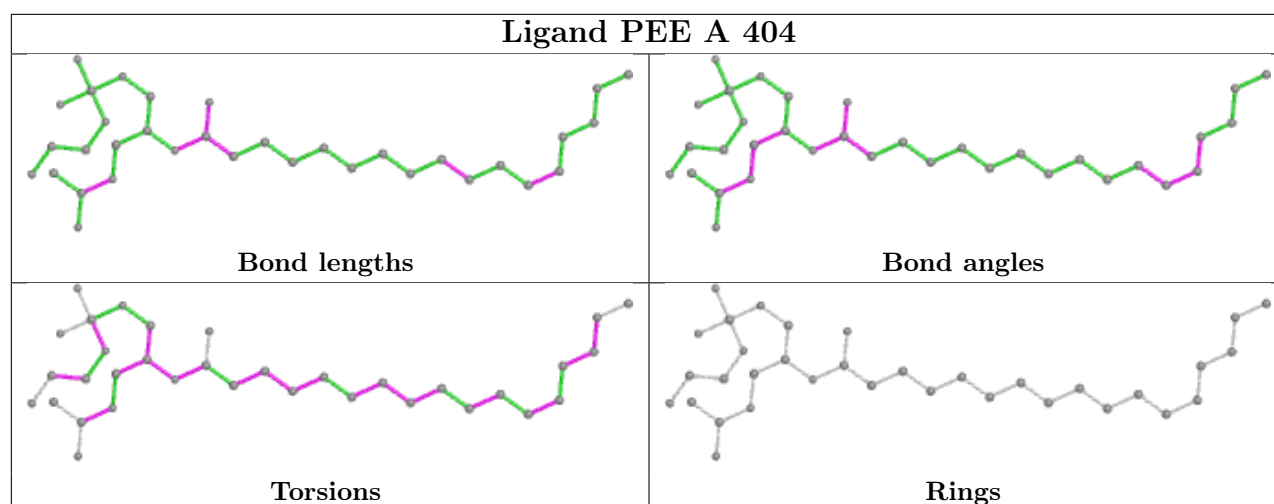
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Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	402	PEE	1	0
2	A	405	PEE	8	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.